Centre for Mechanical Engineering, Materials and Processes

CEMMPRE

PROPOSTA DE PLANO DE DOUTORAMENTO/DOCTORAL PLAN PROPOSAL

(a ser redigido em Inglês / to be filled in English)

ORIENTADOR(A)/SUPERVISOR: Carlos Miguel Almeida Leitão

GRUPO/GROUP: Mechanical and Intelligent Manufacturing

ORIENTADOR(A)/SUPERVISOR: Ana Catarina Da Silva Pinho

GRUPO/GROUP: Materials and Processes

ORIENTADOR(A)/SUPERVISOR: Maria Augusta Neto

GRUPO/GROUP: Mechanical and Intelligent Manufacturing

LOCAL DE REALIZAÇÃO DO TRABALHO/PLACE OF WORK: CEMMPRE/University of Coimbra

TÍTULO DO PLANO DE DOUTORAMENTO/TITLE OF THE DOCTORAL PLAN: Design and characterisation of additive manufactured metallic auxetic materials

RESUMO/SUMMARY (max. 300 words total)

Objetivo/Objectives: Auxetics are structures or materials that have a negative Poisson's ratio and are usually obtained by producing periodic cellular arrangements. The conventional manufacturing technologies like machining, casting, welding and other allied joining processes are ineffective for producing the intricate auxetic shapes, making the additive manufacturing technologies the most suitable tool for obtaining the high geometric freedom necessary in complex auxetic structures. The Fused Filament Fabrication Method (FFFM) has become a suitable alternative for metal printing since it is cost-effective and simple in operation. The proposed fellowship project aims to evaluate the influence of the base metal elastic-plastic properties on metallic auxetics behaviour, for identifying novel auxetic designs,
tailored according to base material properties, and for exploring a low-cost fabrication technique for metallic auxetics. The potential for fabricating auxetics by FFFM will be assessed in terms of process-related aspects like adaptability of the process for various shapes, production time and cost. Sample-related aspects, such as mechanical properties/behaviour, surface roughness, shrinkage, and defects, will be also assessed due to its influence on the auxetic properties.

**Resultados Esperados/Expected Results:** Materials with different mechanical properties, like aluminium, steel, copper and titanium, will be tested in the production of similar lattice structures, in order to determine the influence of base material mechanical properties and anisotropy on its auxetic behaviour. In addition, new auxetic structures will be developed, from basic auxetic structures like chiral and re-entrant model, using topology optimisation technique. Multi-objective functions will be framed with the goal of minimising stress concentration and increasing the negative Poisson’s ratio. The mechanical characterisation of various base materials, complemented with the testing of several auxetic designs, in tension, compression and impact, will enable to better understand the auxetic behaviour and loading bearing capacity. A database will be generated for helping on the selection and design of auxetics for diversified applications.

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